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(54) Name of the invention: Cell type recurrent reflective sheet

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(54) [Name of the invention]

Cell type recurrent reflective sheet

(57) [Summary]

[Goal]

To suggest a recurrent reflective sheet that when used in practice has excellent deformation resistance properties and there is no small flaw generation troubles etc..

[Structure]

Cell type recurrent reflective sheet, characterized by the fact that it is a cell type recurrent reflective sheet obtained from a cell type recurrent reflective base sheet, an adhesive agent layer formed as a laminated layer on the back surface of the above base sheet, and peelable sheet laminated as a layer on the above adhesive agent layer; and the thickness of the above peelable sheet is in the range of 25 microns ~ 200 microns, and also, its extensional strength is higher than 500 kg/cm2.

[Range of the claims of the invention]

[Claim 1]

Cell type recurrent reflective sheet, characterized by the fact that it is a cell type recurrent reflective sheet obtained from a cell type recurrent reflective base sheet, an adhesive agent layer formed as a laminated layer on the back surface of the above base sheet, and peelable sheet laminated as a layer on the above adhesive agent layer; and the thickness of the above peelable sheet is in the range of 25 microns ~ 200 microns, and also, its extensional strength is higher than 500 kg/cm2.

[Claim 2]

Cell type recurrent reflective sheet according to the above described Claim 1 of the present invention, characterized by the fact that the extensional strength of the above described cell type recurrent reflective base sheet is less than 300 kg/cm2.

[Claim 3]

Cell type recurrent reflective sheet according to the above described Claim 1 of the present invention, characterized by the fact that the above described peelable sheet is polyethylene terephthalate type resin sheet that has been treated so that it can be peeled off.

[Detailed description of the present invention]

[0001]

[Technological sphere of application]

The present invention is an invention about a recurrent reflection sheet that can be used in road signs, construction signs and information etc., information signs, automobiles, motorcycles etc., plates, in clothing, lifesaving tools, etc., safety type materials, or billboards etc., markings, etc..

[0002]

[Previous technology]

In the past, the recurrent reflective sheets where the light is reflected and returned to the light source, have been well known and their recurrent reflective properties have been advantageously used. The above described reflective sheets have been advantageously used in the described here above spheres of application.. Among those, the cell type reflective sheets where tight small designed voids (cells) are formed and by that air, etc., low refractive index gas is enclosed tightly in the tight small designed voids (cells) have demonstrated excellent recurrent reflection performance. And because of that the amount used of these materials have increased over the years.

[0003]

Usually, the cell type reflective sheet has a structure formed according to the following. It is a structure where a thin gas layer is enclosed between a protective layer, a substrate material film, and a recurrent reflective material that is provided on the surface of the above protective film or substrate material film, and in both films a large number of tightly enclosed small designed voids are formed and connected. for example, by a shape modification of the above substrate material film or by printing etc., of

adhesive agent on the surface of the substrate material film; the cell type recurrent reflective base sheet that is formed by the continuous linear shape connecting wall, the adhesive sheet that is necessary in order to adhere the recurrent reflective sheet, that is formed as a laminated layer on the above described base sheet, on the subject material, and together with that with the goal to eliminate the adhesion of the adhesive agent on the material that is not the subject, and to eliminate the soiling of the above adhesive agent material, etc., on the above adhesive agent layer, a peelable sheet is used as a lamination layer, where the base material used is polypropylene film, polyethylene laminated paper, etc..

[0004]

Then, in the above described tightly enclosed small designed voids, a large number of recurrent reflective elements, that are obtained as the cube conical elements provided on the surface of a protective film or the recurrent reflective glass beads provided on the surface of the substrate material film, etc., are enclosed. By the common effect together with the low refractive index gas material that is contained inside the above tightly enclosed small designed voids, an excellent recurrent reflective performance is demonstrated.

[0005]

Usually, regarding the cell type recurrent reflective sheet, in the practical applications, it is wound on a paper cylinder with an inner diameter of approximately 75 mm and a thickness of approximately 3 ~ 20 mm, where the length of the tape is from approximately 50 m to approximately 100 m and in this state it is supplied to each customer. Then, this cell type recurrent reflective sheet, usually is cut from the roll to the desired shape by the customer and it is processed by a printing technological process etc., and after that the peelable sheet is peeled off and it is glued onto the subject material. And by that it is processed into an information sign, license plates , safety material type, billboard type signs etc..

[0006]

However, usually in the case of thick cell type recurrent reflective sheet materials where the thickness is in the range from approximately 300 microns ~ approximately 600 microns, in the case when it is rolled into a roll shape, a difference in the length of the front layer side and the back layer side is generated and the front layer side experiences an extensional force, whereas the back layer side experiences a contractional force and because of that a deformation in the sheet is generated. Because of this deformation in many cases different problems are generated.

[0007]

Namely, when the cell type recurrent reflective sheet is unwound from the roll, because of the deformation, because of the difference in the length between the cell type recurrent reflective base sheet that is usually on the front layer side and the release sheet that is usually on the back layer side, and also because of the pressure caused by the compressive type deformation etc., the base sheet or the protective film , or also in some more serious cases, in both the base sheet and the protective film, small flaws are generated and the smoothness properties are lost. And because of that there are many cases when different problems are generated like for example, the printing processing technological process becomes difficult, and the appearance etc., become poor. Also, when a cell type recurrent reflective sheet is used that has been unwound from the roll, in the case when by using a cutting machine it is kiss cut at the cutting mark, etc., even in that case, at the cut marks small flaws are generated etc., and troubles are generated> And because there are many cases like that in the practice these become big problems.

[0008]

Regarding such troubles, usually, it is considered that when the bending ratio is large, the generated deformations are large, and those occur a lot in the central wound part of the roll type material. However, in the case when the cell type recurrent reflective sheet material does not contain outside gas layers, the generation of such problems in the cell type recurrent reflective sheet material is decreased. Consequently, the specific structure of the cell type recurrent reflective sheet material is considered as the main reason for the generation of trouble, and also, at least it is considered that this specific structure is promoting the generation of such trouble.

[0009]

[Problems solved by the present invention]

Regarding the present invention, it is an invention where these drawback points according to the previous technology are considered and it is an invention that is suggesting a cell type recurrent reflective sheet material where in the practical applications as described above, there are no troubles caused by the generation of small flaws etc., and it has excellent deformation resistant properties.

[0010]

The authors of the present invention have conducted many different types of experiments in order to improve the deformation resistance properties of the cell type recurrent reflective sheet material. As a result from that they have observed and learned that by a simple procedure where the used in the past

flexible release (peelable) sheet is substituted with a sheet possessing hardness properties, material with excellent deformation resistant properties, is obtained.

[0011]

[Measures in order to solve the problems]

Thus, according to the present invention, a cell type recurrent reflective sheet is suggested, that is characterized by the fact that it is a cell type recurrent reflective sheet obtained from a cell type recurrent reflective base sheet, an adhesive agent layer formed as a laminated layer on the back surface of the above base sheet, and peelable sheet laminated as a layer on the above adhesive agent layer; and the thickness of the above peelable sheet is in the range of 25 microns ~ 200 microns, and also, its extensional strength is higher than 500 kg/cm2.

[0012]

Here below, the present invention will be described in more detail. Regarding the release sheet used according to the present invention, it is necessary to be a synthetic resin sheet material where its extensional strength is higher than 500 kg/cm2. In the case when the extensional strength is less than 500 kg/cm2, it is difficult to obtain excellent deformation resistant properties. In order to obtain still more preferred deformation resistant properties, it is a good option if the extensional strength of the release sheet is higher than 1000 kg/cm2, then more preferably, higher than 1500 kg/cm2, and then especially more preferably, higher than 2000 kg/cm2.

[0013]

Also, regarding the thickness of the release sheet according to the present invention, it is necessary to be in the range of 25 ~ 200 microns. In the case when the above described thickness is less than 25 microns, it is difficult to obtain preferred deformation resistance properties. And also, in the case when the thickness is larger than 200 microns, the technological processing properties become poor, and the costs also become unfavorable. Regarding the thickness of the above described release sheet material, from the point of view of the deformation resistance properties, the technological processing properties, the cost structure etc., it is preferred to be in the range of 35 ~ 150 microns, and then still more preferably in the range of 40 ~ 100 microns.

[0014]

Regarding the release sheet according to the present invention, as long as it is a material where the above described requirements for the extensional

strength and the thickness are satisfied, there are no specific limitations. However, polyethylene terephthalate resin type sheet that has been treated with a release type treatment like a silicone resin etc., and that has excellent smoothness properties, is a preferably used material.

[0015]

As the used according to the present invention cell type recurrent reflective base sheet, there are no specific limitations and it is a good option to use the well known capsule lense type material, capsule cube cone type material etc..

[0016]

For example, in the formation of the capsule lense type cell type recurrent reflective element it is possible to use the following type method. First on a polyethylene laminated processed paper etc., backing substrate material glass beads that have a refractive index in the range of 1.7 ~ 2.0, an average particle diameter in the range of 40 ~ 90 microns, and that are buried to approximately 1/2 ~ 1/3, are supported, and on the top surface of that a metal vapor deposition using aluminium etc., is conducted and by that on the approximately semi-spherical exposed surface of the glass beads a metal vapor deposition film is formed. After that, on this backing substrate material a supporting material film that has a thermoplastic resin surface, is placed and the glass beads side of the above backing substrate material and the supporting material film are pressured together. By that the part where metal vapor deposition on the above glass beads has been conducted is practically buried in the above substrate material film. And after that, the above described backing material is separated as a whole. Also, it is also a good option if on the surface of the above described backing substrate material, instead of placing the supporting material film, the resin solution that is used for the formation of the supporting material film is coated and then dried.

[0017]

Also, regarding the formation of the cube cone type recurrent reflective type element, it is possible to advantageously use the following method. For example, on a transparent synthetic resin sheet an embossing technological process is conducted by using an embossing roll that has concave shape cube cone type elements, and by that along the whole surface on one side of the above sheet a large number of protruded cube cone shaped recurrent reflective type elements, are formed , etc., methods can be used.

[0018]

Regarding the cell type recurrent reflective base sheet according to the present invention, in the case of the capsule lense type material, for example, it is

possible to be manufactured according to the following method. For example, on the surface with the glass beads that are buried in the supporting film of the capsule lense type recurrent reflective element, a protective film is provided. then by a thermal embossing technological process that is applied from the back surface of the above supporting film, the above described supporting material film is thermally shaped (the shape is changed) and by that a continuous linear type connecting wall is formed. By that by both films, a large number of tightly enclosed small designed voids are formed and connected.

[0019]

Also, in the case of the cube cone type material, it is possible to manufacture a cube cone type cell type recurrent reflective base sheet according to the following method. For example, on the surface of the where the cube cone type recurrent reflective element has been embossed by the embossing technological process, a supporting material film is provided, and from the back surface of the above described supporting material film, the same way, a thermal embossing technological process is used and by that a continuous linear type connecting wall is formed. By that by both films, a large number of tightly enclosed small designed voids are formed and connected.

[0020]

As the supporting material film that is used in the manufacturing of the cell type recurrent reflective base sheet manufacturing, preferably, it is a good option if it is a film with a multilayer type of structure, containing at least 2 layers, i.e. a heat softening bonding resin layer, where in order to obtain as much as possible a homogeneous and also constant state of the connecting wall part that is formed by the thermal shaping etc., process, the recurrent reflective glass beads are buried, and by the thermal embossing technological process the continuous linear shape connecting wall is formed; and a reinforcing resin layer forming the surface of the opposite side of the surface with the buried glass beads, and that is reinforcing the above described bonding resin layer.

[Practical Examples]

Here below, the present invention will then be explained in more detail by using practical examples.

[0021]

Practical Example 1

Processed paper where a polyethylene type resin has been laminated at a thickness of approximately 20 microns on paper is heated to approximately 105oC, and on the surface of that material glass beads with an average particle diameter of approximately 65 microns and a refractive index of approximately 1.91, are homogeneously and also densely dispersed. By using a nip roll a pressure is applied and the glass beads are buried in the polyethylene resin layer up to approximately 1/3 of their diameter. After that, on the processed paper surface with the above described buried glass beads, by using a vacuum vapor deposition equipment, aluminium is vacuum vapor deposited, and by that on the surface of the glass beads a vapor deposition film with a thickness of approximately 0.1 microns, was formed.

[0022]

After that, on the surface of a silicone treated polyethylene terephthalate processed film, based on the compositions shown according to Table 1, the resin composition material used for the formation of the reinforcing resin layer, is coated so that its thickness after drying is approximately 40 microns, and then it is dried and by that the reinforcing resin layer is formed. Then, on the surface of this reinforcing resin layer the resin composition material used for the formation of the bonding resin layer, is coated so that its thickness after drying becomes approximately 80 microns, and then it is dried and by that the bonding resin layer is formed. After that, on the side of the aluminium vapor deposition film of the processed paper with the buried glass beads, the bonding resin layer side of the above described laminated layer material is placed and then an elevated pressure is applied. By that the glass beads are incorporated and buried into the bonding resin layer up to approximately 1/3 of the diameter. After that, in this state an aging is conducted for 14 days at a temperature of 35oC and the crosslinking of the reinforcing resin layer is completed.

[0023]

The polyethylene resin laminated processed paper is removed from this laminated layer material and on the surface of the exposed glass beads an unoriented acrylic type film with a thickness of approximately 75 microns and a total light permeability coefficient of approximately 93 %, was placed. Then, in the space between a metal roll with a surface temperature of approximately 190oC and that has embossed on its surface protrusions with a network type of shape where the line width is 0.3 mm, and a rubber roll with a surface temperature of approximately 60oC, this material is passed while an elevated pressure is applied so that the acrylic film side is in contact with the rubber roll. By that the thermal shape change process is conducted and tight small designed voids are formed. From this thermally shaped type material, the processed film is removed and by that the cell type recurrent reflective base sheet material is manufactured.

[0024]

After that, on the silicone release treatment surface of the approximately 50 microns thick polyethylene terephthalate (PET) that is used as the release type sheet material, a solution of an acrylic type pressure sensitive agent is coated and dried. And by that a layer of a pressure sensitive adhesive agent with a thickness of approximately 40 microns, is formed. This is then glued on the reinforcing resin layer of the above described base sheet material and by that a capsule lense type recurrent reflective sheet material is manufactured.

[0025]

Regarding the measurement of the separation strength of the separation between the base sheet and the release sheet of the obtained capsule lense type recurrent reflective sheet material, it is conducted in an ambient environment at a temperature of 23oC and a supporting length of 50 mm, extension speed of 200 mm/min. And according to that measurement, the extensional strength of the release sheet material was 1900 kg/cm2.

[0026]

Approximately 50 meters of a capsule lense type recurrent reflective sheet material according to the previous technology was wound on a paper tube with an internal diameter of 3 inches and a thickness of 8 mm, and it was stored for 10 days in an ambient atmosphere at a temperature of 50oC.After that it was cooled down to a room temperature and after that it was unwound and then the state of flaw generation was visually observed. Experiments were conducted by using the resin compositions shown according to table 1 in the formation of the reinforcing resin layer, the bonding resin layer and the adhesive agent layer. The results from these experiments are shown in table 2.

[0027]

Practical Example 2

According to the Practical Example 1, except that the thickness of the release sheet was approximately 75 microns, and everything else was conducted according to the technological procedures of the Practical Example 1. By that a capsule lense type recurrent reflective sheet material was manufactured.Here below, the same tests that have been conducted according to the Practical Example 1 were conducted. Experiments were conducted by using the resin compositions shown according to table 1 in the formation of the reinforcing resin layer, the bonding resin layer and the adhesive agent layer. The results from these experiments are shown in table 2.

[0028]

Practical Example 3

According to the Practical Example 1, except that the thickness of the release sheet was approximately 100 microns, and everything else was conducted according to the technological procedures of the Practical Example 1. By that a capsule lense type recurrent reflective sheet material was manufactured.Here below, the same tests that have been conducted according to the Practical Example 1 were conducted. Experiments were conducted by using the resin compositions shown according to table 1 in the formation of the reinforcing resin layer, the bonding resin layer and the adhesive agent layer. The results from these experiments are shown in table 2.

[0029]

Practical Example 4

According to the Practical Example 1, except that the composition of the bonding type resin material was changed as shown according to Table 1, and the thickness of the release sheet was approximately 75 microns, and everything else was conducted according to the technological procedures of the Practical Example 1. By that a capsule lense type recurrent reflective sheet material was manufactured.Here below, the same tests that have been conducted according to the Practical Example 1 were conducted. Experiments were conducted by using the resin compositions shown according to table 1 in the formation of the reinforcing resin layer, the bonding resin layer and the adhesive agent layer. The type and the thickness of the used release type sheet and results from these experiments are shown in table 2.

[0030]

Reference Example 1

According to the Practical Example 1, except that the thickness of the release sheet was approximately 20 microns and everything else was conducted according to the technological procedures of the Practical Example 1. By that a capsule lense type recurrent reflective sheet material was manufactured.Here below, the same tests that have been conducted according to the Practical Example 1 were conducted. Experiments were conducted by using the resin compositions shown according to table 1 in the formation of the reinforcing resin layer, the bonding resin layer and the adhesive agent layer. The type and the thickness of the used release type sheet and the results from these experiments are shown in table 2.

[0031]

Reference Example 2

According to the Practical Example 1, except that as a release sheet material an unoriented polypropylene (PP) film where the thickness of the release sheet was approximately 80 microns was used. And everything else was conducted according to the technological procedures of the Practical Example 1. By that a capsule lense type recurrent reflective sheet material was manufactured. Here below, the same tests that have been conducted according to the Practical Example 1 were conducted. Experiments were conducted by using the resin compositions shown according to table 1 in the formation of the reinforcing resin layer, the bonding resin layer and the adhesive agent layer. The type and the thickness of the used release type sheet and the results from these experiments are shown in table 2.

[0032]

Table 1

Headings for the table:
1. Practical Example, 2. Reference Example, 3. materials used, 4. reinforcing resin layer, 5. bonding resin layer, 6. adhesive agent layer, 7. titanium oxide, 8. component *2, 9. HMDI type isocyanate crosslinking agent, 10. cellulose type resin, 11. rutile type titanium oxide, 12. HMDI type isocyanate crosslinking agent, 13. acrylic type pressure sensitive adhesive agent, 14. HMDI type isocyanate crosslinking agent.

*1.....manufactured by Nippon Carbide Industries Company
*2.....EA: ethylacrylate, BA: butylacrylate, MMA: methylmethacrylate
HEMA: 2-hydroxy ethylmethacrylate, AA: acrylic acid
HMDI: hexamethylene diisocyanate

[0033]

[Table 2]

Headings for Table 2:
1. Practical Example, 2. Reference Example, 3. extensional strength of the base sheet (kg/cm2), 4. release type film, 5. state of generation of the small flaws *3, 6. type, 7. thickness, 8. extensional strength (kg/cm2), 9. same as on the left side.

Evaluation standards for the state of the small flaws generation

5: there are no small flaws
3: there are small flaws generated within 5 m and more from the center of the bobbin
1: there are small flaws almost all over the whole surface

[0034]

[Results from the present invention]

Regarding the cell type recurrent reflective sheet material according to the present invention, it is a material that consists of a cell type recurrent reflective base sheet, and a release type sheet that formed by the lamination of an adhesive agent layer that is formed as a lamination layer on the back surface of the above base sheet, and a release type sheet that is laminated on the above described adhesive agent laminated layer. And it is a material whose characteristic is the fact that as the release type sheet material, a sheet is used that has high hardness properties and that possesses a specific thickness and extensional strength.

[0035]

By using this material, the cell type recurrent reflective sheet material according to the present invention becomes a material where under the conditions of the practical application, there are no troubles at all because of generation of small flaws, and it is a material that has excellent deformation resistant properties.

Patent Assignee: Nippon Carbide Industries Company

Translated by Albena Blagev : (6-7946)

1/30/96

【表1】

	使用材料	実施例 1	実施例 2	実施例 3	実施例 4	比較例 1	比較例 2	成分 *2
補強樹脂層	SX-5350 *1	100	100	100	100	100	100	EA/MMA/HEMA
	CK-102 *1	14	14	14	14	14	14	HMDI系イソシアネート架橋剤
接合樹脂層	KP-1634A *1	57	57	57	100	57	57	EA/MMA/AA
	KP-1703A *1	43	43	43	0	43	43	MMA/BA
	SX-5150 *1	34	34	34	0	34	34	セルロース系樹脂
	SX-5285 *1	12	12	12	0	12	12	ルチル型酸化チタン
	酸化チタン *7	17	17	17	40	17	17	HMDI系イソシアネート架橋剤
	CK-102 *1	0	0	0	1	0	0	アクリル系感圧接着剤
接着剤層	KP-1384 *1	100	100	100	100	100	100	HMDI系イソシアネート架橋剤
	CK-103A *1	1.2	1.2	1.2	1.2	1.2	1.2	

		実施例 1	実施例 2	実施例 3	実施例 4	比較例 1	比較例 2
ベースシート引張強度 (kg/cm²)		130	同左	同左	140	130	同左
剥離性フィルム	種類	PET	同左	同左	同左	同左	PP
	厚み (μm)	50	75	100	75	20	80
	引張強度 (kg/cm²)	1900	2000	2100	2000	1800	300
カジワ発生状況 *3		5	5	5	5	3	1